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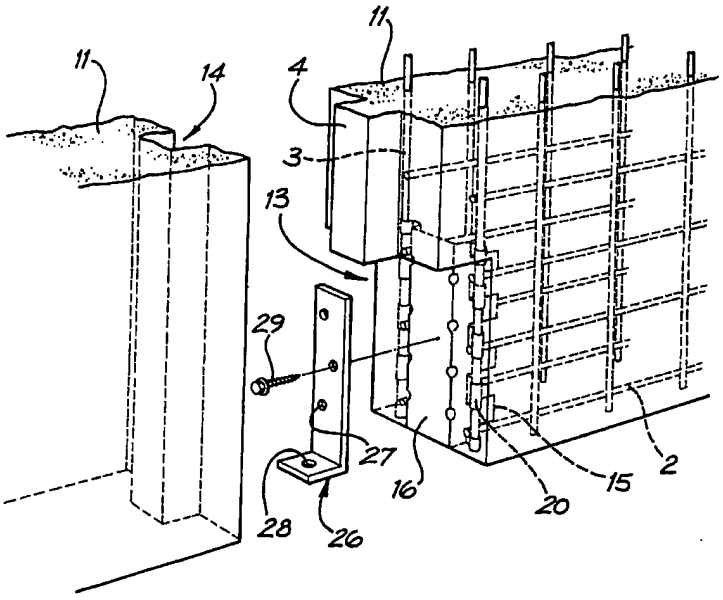
(54) Title: AUTOCLAVED AERATED CONCRETE BUILDING PANEL SYSTEM



(57) Abstract: The present invention discloses a cast autoclaved aerated concrete building panel (11) in which a foundation plate (15, 35, 45) is attached to reinforcing (2, 3) within the panel. A force transfer member such as a bracket (26, 56) is secured to a floor (12) and/or a soffit (21) and to the foundation plate. The foundation plate can include protrusions (36, 46) which engage the bracket (26, 56) and which are preferably stamped from the plate itself.

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TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

AUTOCLAVED AERATED CONCRETE BUILDING PANEL SYSTEM

Field of the Invention

The present invention relates to building panels and, in particular, to building panels for creating walls fabricated from autoclaved aerated concrete (AAC). The invention also includes panels made from other forms of lightweight concrete, plastics materials including foam materials, and the like.

Background Art

AAC panels are both lightweight and strong and for this reason have found a ready market in building construction. In particular, such panels are positioned in a co-planar relationship with edge-to-edge abutment in order to form a wall of a building. The edges are normally provided with tongue and groove mating surfaces and are glued in the edge-to-edge relationship. It is, however, necessary that the panels be secured to the floor and/or soffit. For this purpose hitherto an angle bracket which is directly secured to the floor and directly to the AAC has been widely used because it is economical in both cost and time and represents a very simple fixing method. However, such an arrangement has a strength which is limited by the degree to which the fasteners penetrate the AAC and the consequent size of their zone of influence in the material. The typical failure mechanism of such a fixing arrangement is for the AAC to break away from the panel and thus the strength of the arrangement is limited by the strength of the AAC.

It is also known to provide joining members which are cast into concrete articles at the time they are formed. Such articles include tilt-up concrete walls and pre-cast floor, beam or column elements. Such joining members protrude from the surface of the panel and are then connected, for example, by welding or bolting to the adjacent structure. Such cast in protrusions suffer from the significant disadvantage that they are prone to snag and/or be bent during handling of the panel between its fabrication and installation.

Object of the Invention

It is the object of the present invention to improve upon, and/or provide an alternative to, the abovementioned arrangements by the provision of a panel having an improved fixing arrangement which both does not protrude significantly beyond the surface of the panel, and also has a strength which is not limited by the strength of the AAC itself.

Summary of the Invention

In accordance with a first aspect of the present invention, there is disclosed a building panel for creating walls, said panel having reinforcement located interior of the panel wherein a foundation plate is connected with said reinforcement prior to, or during, fabrication of said panel and has a surface lying beneath, or substantially flush with, a surface of said panel after fabrication whereby a force transfer member can be connected to said plate to mount said panel.

In accordance with a second aspect of the present invention, there is disclosed a method of mounting a plurality of like cast building panels, each of said panels being positioned in substantially co-planar arrangement with edge to edge abutment and with abutting edges being glued together, said method comprising the step of connecting a force transfer member between a floor and/or a soffit between which said panels are placed, and a foundation plate in each said panel, each said plate being connected with interior reinforcement in the corresponding panel and being substantially flush with, or lying beneath, a surface of said panel.

Brief Description of the Drawings

Embodiments of the present invention will now be described with reference to the drawings in which:

Fig. 1 is an exploded perspective view of a prior art fixing method,

Fig. 2 is a side elevation of the bottom portion of two adjacent abutting vertically mounted panels in accordance with the first embodiment,

Fig. 3 is an exploded perspective view of the joint of Fig. 2,

Fig. 4 is a perspective view of the foundation plate utilised in the arrangements of Figs. 2 and 3,

Fig. 5 is a side elevational view of a wall fabricated from a plurality of like panels and including a window opening,

Fig. 6 is a view similar to Fig. 4 but of a foundation plate of a second embodiment, and

Fig. 7 is a perspective view of a foundation plate and bracket of a third embodiment.

Detailed Description

As seen in Fig. 1, a prior art panel 1 formed from AAC has two substantially parallel sheets 2, 3 of steel mesh which reinforce the interior of the panel 1. The panel 1 has at one edge a tongue 4 and at the opposite edge (not illustrated) a corresponding groove (14 in Fig. 3) to enable the abovementioned tongue and groove edge abutment to be achieved. At the base of the panel 1 the tongue 4 is either not formed or is cut away so as to leave a flat surface 5. This modification can be made to the top of the panel also, and also at both edges.

In order to mount the panel 1 in a vertical orientation, an L-shaped angle bracket 6 is provided which has a plurality of V-shaped apertures 7 in its vertical arm and a single hole 8 in its base. The bracket 6 is secured to the flat surface 5 by means of driving V-shaped nails 9 each through the corresponding V-shaped aperture 7 and into the AAC of the panel 1. Then the floor is drilled through the hole 8 and an expandable bolt fastener is passed through the hole 8 and into the floor to thereby secure the bracket 6 to the floor.

The above described arrangement is economical in terms of cost of components and speed of erection, however, the load strength which the bracket 6 is able to transfer from the panel is limited by the strength of the AAC adjacent the flat face 5. Typical failure mechanisms involve a portion of the AAC containing the nails 9 to break away from the remainder of the panel. Thus, the strength of the AAC is the limiting factor.

A preferred embodiment which provides greater strength is illustrated in Figs. 2–4. In Fig. 2, two adjacent panels 11 are illustrated, with the right-hand panel having

a tongue 4 as before. The two panels 11 are supported by a floor 12 and in one lower corner of the panel 11 a recess 13 is formed. The recess 13 is illustrated in more detail in Fig. 3.

As seen in Fig. 3, the interior of both panels 11 is substantially the same as for the panel 1 again having two sheets 2, 3 of steel mesh in parallel arrangement and co-planar with the panel. For ease of illustration the mesh 2, 3 is only illustrated in the right hand panel. However, engaged with the sheets 2, 3 is a foundation plate 15 illustrated in more detail in Fig. 4. The plate 15 is preferably formed from steel and has a front surface 16, two side walls 17, 18 each of which is deformed by having cantilever arms 19, the free end of each of which is curled at 20 so as to form a means of snap-engaging the bars of the reinforcing sheets 2, 3. If so desired, the front surface 16 may include apertures 22.

Prior to fabrication of the panels 11, the sheets 2, 3 of steel mesh are placed in their intended final position and the plate 15 is snap-engaged with the rods from which the sheets 2, 3 are fabricated, in the manner schematically illustrated in Fig. 3. Then a block of volatile or vaporisable plastics material, such as polystyrene, is glued or otherwise attached to the front surface 16 of the plate 15. Then the aerated concrete mix is cast in a mould and autoclaved in the usual fashion. The autoclaving vaporises the polystyrene thereby creating the recess 13. In this way, the front surface 16 is substantially flush with the surface of the concrete (thereby avoiding snagging) and no on-site cutting of the panel is required.

In order to mount the panel, an angle bracket 26 having apertures 27 and hole 28 is provided and self-drilling and self-tapping screw fasteners 29 (only one of which is illustrated in Fig. 3) are passed through the apertures 27 and cut and tap corresponding holes in the front surface 16. The angle bracket 26 is then secured to the floor via the hole 28 as before. Fig. 3 also illustrates the groove 14 which mates with the tongue 4.

In a variation from the illustrated arrangement, the plate 15 can be made much longer than illustrated in Fig. 4 and have a length substantially equal to the height of

the panel. In which case there is an associated increase in structural capacity and stiffness that is advantageous at certain locations such as adjacent to an opening in the wall. Conveniently, the plate 15 extends substantially all the way from the base to the top of the panel. In addition, the plate 15 is preferably also provided at each opposite edge of the panel 11. This enables the mounting arrangements around openings, such as the window opening illustrated in Fig. 5, to be achieved.

In Fig. 5, the right-hand one 11A of a number of panels 11 is aligned vertically with a wall or column 30, and normally separated therefrom by a small gap (typically of 10-15mm). The panel 11A is then fixed to the wall or column 30 using metal dowels 25, or like conventional arrangements, which pass both into the AAC of the panel 11A and into the concrete of the wall or column 30. The small gap is filled or covered with a sealant as required.

In addition, angle brackets 26 are used to secure the panel 11A both to the floor 12 and the soffit 21. Then the next panel 11B is glued to the first panel 11A by means of glue being applied, typically as a thin bed adhesive, to the tongue and groove joint formed between the two panels. Next two brackets 26 are secured to the vertically extending plate 15 within the left-hand edge of the panel 11B. A short panel 11C is then secured to the panel 11B, the panel 11C being cut to a height representing the height of a window-sill. The panel 11C is further secured by means of attachment via a bracket 26.

In addition, a lintel 31 is secured to the upper of the two brackets 26 and another short panel 11D is then positioned on top of the lintel 31 and glued to the panel 11B. Next a full height panel 11E is glued to panels 11C and 11D and a further pair of brackets 26 used to make good the securing of the lintel 31 and sill panel 11C. Then wall panels 11F and 11G are secured to the growing wall in turn.

It will be appreciated by those skilled in the mechanical arts that because the plate 15 is secured to the sheets 2, 3 (both by mechanical engagement of the curled ends 20 and by being embedded within the concrete surrounding the sheets 2,3), mechanical loads transferred to the plate 15 are thereby transferred to the sheets 2,3.

As a consequence, external mechanical loads are applied to the interior reinforcement of the panel 11. Consequently, the entire structure is much stronger than the arrangement described in Fig. 1.

With the arrangement illustrated in Fig. 5, preferably cavities similar to cavity 13 are created by vaporising a block of material at the desired height of the lintel and the sill for the window of the wall, so as to avoid the need for AAC to be chipped away from the panel at the site of erection. It will also be apparent to those skilled in the art that the above described arrangements do not result in any protruding lugs, brackets, ears or the like which are liable to be snagged upon other objects and/or bent or otherwise deformed between manufacture of the panel and its final installation.

Although the plate 15 with its front surface 16 preferably lies substantially flush with the surface of the concrete within the cavity 13, it will be apparent to those skilled in the art that the front surface 16 can be reached by the shanks of fasteners which pass through the concrete where there is no corresponding cavity 13. Thus, although the front surface 16 is not exposed, those carrying out the installation know its whereabouts and are able to make good mechanical connection therewith.

Turning now to Fig. 6, a second embodiment of the present invention incorporating a modified form of a plate 35 is illustrated. The plate 35 has L-shaped upstands 36 which slidingly receive the bracket 26 and which are punched out of the material of the plate 35. In addition, the cantilever arms 39 are again curled at 40, however, the curl 40 opens in the opposite direction to the curl 20 of the arms 19 of Fig. 4. Again the function of the arms 39 and curls 40 is to snap engage with the internal reinforcement 2, 3 prior to forming the panel.

A still further embodiment with another form of plate is illustrated in Fig. 7. Here the plate 45 has U-shaped upstanding retainers 46 which are again pressed from the metal of the plate 45. Each retainer 46 forms an opening able to receive a modified bracket 56 with elongate apertures 57 and elongate mounting hole 58. As for the embodiment of Fig. 6, the plate 45 has arms 39 and curls 40.

During fabrication, the abovementioned polystyrene block is abutted against the plate 35, 45 and the upstands 36, or retainers 46 as the case may be, penetrate the polystyrene. Thus, after the autoclaving step the upstands 36 or retainers 46 are proud of the autoclaved aerated concrete. However, these minimalist protrusions are located within the recesses 13 and thus do not extend beyond the exterior envelope of the panel 11. In particular, the upstands 36 or retainers 46 are protected by the groove 4 from being snagged during handling of the panel 11 to its erection. A recess 13 need only be positioned at those locations where the plate 35, 45 is provided with upstands 36 or retainers 46.

As schematically indicated in Fig. 7, during the erection procedure, the bracket 56 is slidingly engaged with the retainers 46. Thereafter, the bracket 56 is bolted to the floor by means of a bolt which passes through mounting hole 58. If desired, no fasteners such as 29 in Fig. 3 need to be used at all since the retainers 46 adequately interconnect the panel 11 and bracket 56. A similar comment applies to upstands 36 on plate 45. A similar bracket 26, 56 can be used to secure the panel 11 to a roof beam, ceiling, or the like, if desired.

The foregoing describes only some embodiments of the present invention and modifications, obvious to those skilled in the art, can be made thereto without departing from the scope of the present invention. For example, the plates 15, 35 or 45 can be provided only at the base of one edge of the panel 11; at the top of, and at the base of, the one edge of the panel 11; at the base only of two opposite edges of the panel 11; or at the top of, and base of, the opposite edges of the panel 11.

Alternatively, the plates 15, 35 or 45 can be elongated and extend along substantially the entire length of one or both edges. Alternatively, short length plates 15, 35 or 45 can be located at the height of window lintels and sills.

Further modifications include forming the apertures 27 in the brackets 26 as elongate slots in the manner of slots 57 in Fig. 7. This is particularly advantageous where the brackets are used to secure the panels to an overhead soffit. Normally a small gap would be provided between the tops of the panels and the soffit. This can

allow the floor of the storey above the panels to deflect under dynamic loads. In this circumstance the bracket 26 can then move relative to the fastener 29 and thereby take up the necessary relative movement between soffit and panels.

Similarly, although fasteners 29 are illustrated, there are various other mechanisms by means of which the bracket 26, 56 can be attached to the foundation plate 15, 35, 45. These include nails, rivets, and other mechanical arrangements, welding, or the like.

In addition, the foundation plate 15, 35, 45 can be positioned at any location around the periphery of the panel 11 where either a heavy load is expected or a fixture of some sort is required to be fixed to the panel.

In a similar manner, the deformation of the foundation plate 15, 35, 45 such as apertures 22, upstands 36 or retainers 46 can be used in any one of the various types of foundation plate, not merely the specific one illustrated. Likewise the foundation plates themselves can be attached to the reinforcing mesh 2, 3 by means such as welding or tying other than the snap engagement mechanisms 20, 40 illustrated. In this connection an extra advantage of the foundation plate 15, 35, 45 is that it acts as a shear stiffener and resists the mesh reinforcing 2, 3 from separating or moving relative to each other. Thus there is less likelihood that the panel 11 will delaminate.

In addition, although in Fig. 5 all the panels 11 are illustrated in a vertical orientation, it is equally possible for the panels 11C and 11D to be formed by orienting a panel 11 horizontally, rather than vertically. In such an arrangement, the brackets 26 at the corners of the window opening are then able to directly interconnect one foundation plate to another. Such horizontally oriented panels can be stacked one above the other to reach a desired wall height or height of a window sill, for example.

Although concrete floors 12 and soffits 21 have been described in the detailed description, it is to be understood that these structures could also be fabricated from steel decks, timber, and the like.

The term "comprising" (and its grammatical variations) as used herein is used in the inclusive sense of "having" or "including" and not in the exclusive sense of "consisting only of".

CLAIMS

1. A building panel for creating walls, said panel having reinforcement located interior of the panel wherein a foundation plate is connected with said reinforcement prior to, or during, fabrication of said panel and has a surface lying beneath, or substantially flush with, a surface of said panel after fabrication whereby a force transfer member can be connected to said plate to mount said panel.
2. The panel as claimed in claim 1 wherein said reinforcement is fabricated from metal.
3. The panel as claimed in claim 2 wherein said reinforcement comprises at least one sheet of steel mesh being substantially co-planar with said panel.
4. The panel as claimed in claim 3 wherein said reinforcement comprises a pair of substantially parallel sheets of steel mesh.
5. The panel as claimed in any one of claims 1-4 wherein said plate is connected to said reinforcement prior to fabrication of said panel.
6. The plate as claimed in claim 5 wherein said plate is clipped onto said reinforcement.
7. The plate as claimed in any one of claims 1-6 and comprising a cast masonry panel.
8. The panel as claimed in claim 7 and fabricated from autoclaved aerated concrete.
9. The panel as claimed in claim 8 wherein a shaped piece of vaporisable material is placed adjacent said plate surface prior to autoclaving whereby loss of said vaporisable piece during autoclaving locates said plate surface at said panel surface after autoclaving.
10. The panel as claimed in any one of claims 1-9 wherein said plate includes portions bent to increase the inter-engagement of said plate and panel.
11. The panel as claimed in any one of claims 1–10 wherein said plate extends a substantial distance along one edge of said panel.
12. The panel as claimed in claim 11 and having two said plates each extending a substantial distance along a corresponding opposite edge of said panel.

13. The panel as claimed in claim 11 or 12 and including at least one plate at a predetermined location adjacent the periphery of said panel.
14. The panel as claimed in any one of claims 1-13 where said force transfer member is connected to said plate by at least one fastener.
15. The panel as claimed in any one of claims 1-14 wherein said plate has protrusions which engage said force transfer member.
16. The panel as claimed in claim 15 wherein said protrusions are formed by being partially stamped from said plate.
17. The panel as claimed in any one of claims 1-16 wherein said force transfer member comprises an L-shaped bracket.
18. A method of mounting a plurality of like cast building panels, each of said panels being positioned in substantially co-planar arrangement with edge to edge abutment and with abutting edges being glued together, said method comprising the step of connecting a force transfer member between a floor and/or a soffit between which said panels are placed, and a foundation plate in each said panel, each said plate being connected with interior reinforcement in the corresponding panel and being substantially flush with, or lying beneath, a surface of said panel.
19. The method as claimed in claim 18 including the step of forming protrusions on said plate which engage with said force transfer member.
20. The method as claimed in claim 19 including the step of forming said protrusions by stamping said plate.
21. The method as claimed in any one of claims 18-20 including the step of fixing fasteners through said force transfer member and into said plate.
22. The method as claimed in any one of claims 18-21 including the step of fixing a fastener through said force transfer member and into said floor and/or into said soffit.
23. The method as claimed in any one of claims 18-22 wherein said plate extends along substantially one edge of said panel and a lintel is secured thereto.
24. The method of claim 23 including the step of supporting a further cast panel by said lintel.

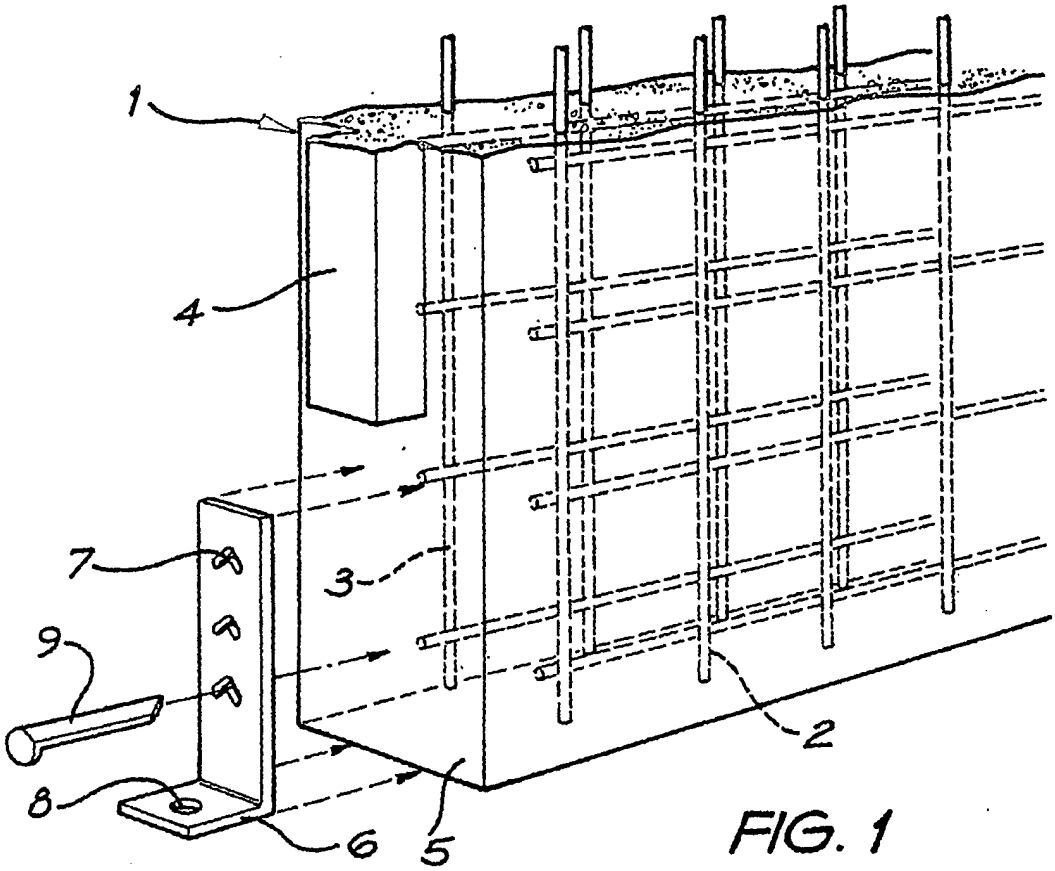


FIG. 1
PRIOR ART

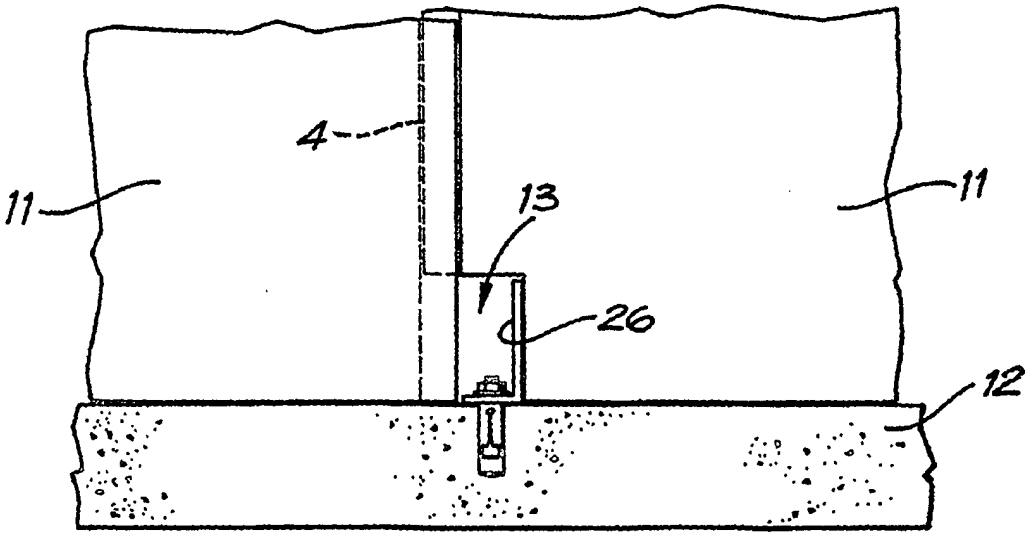


FIG. 2

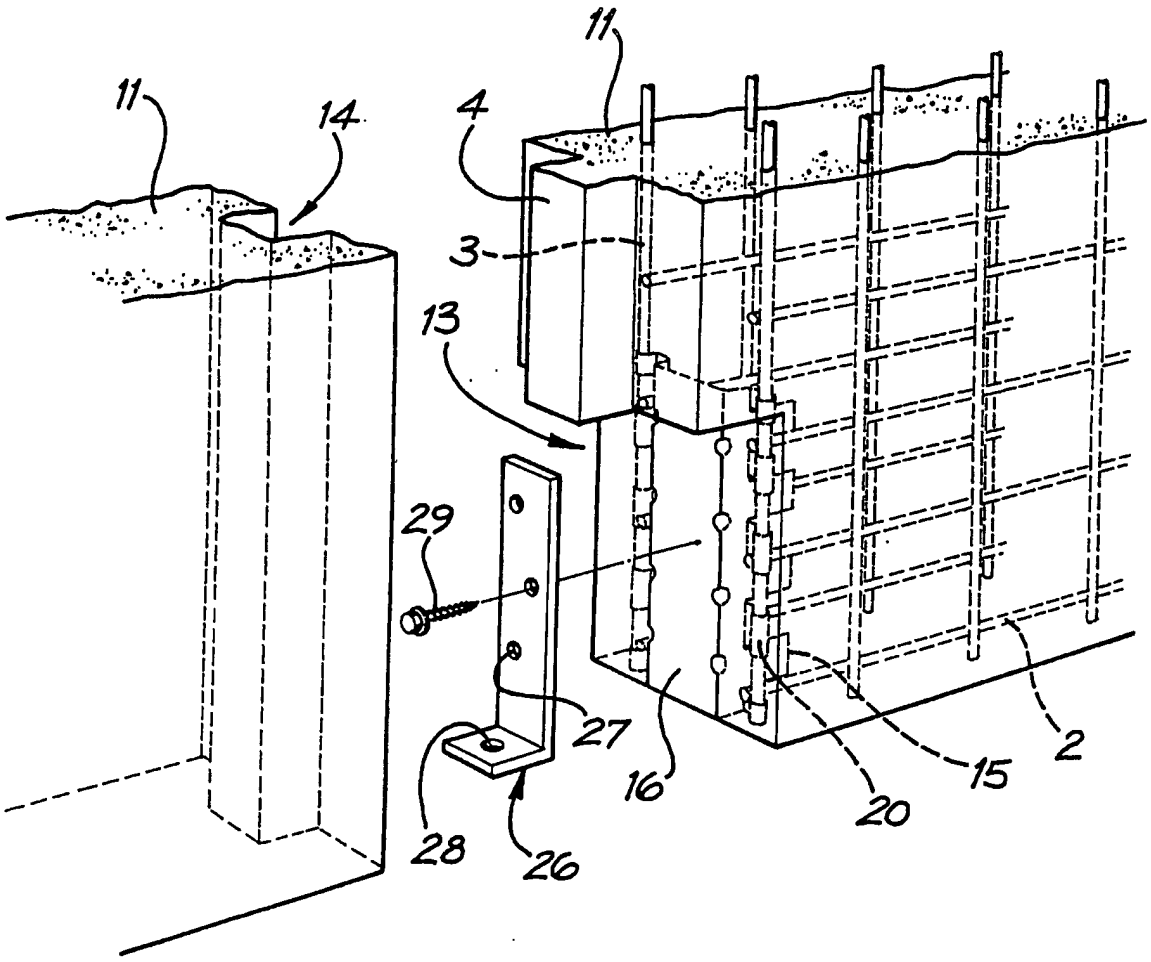
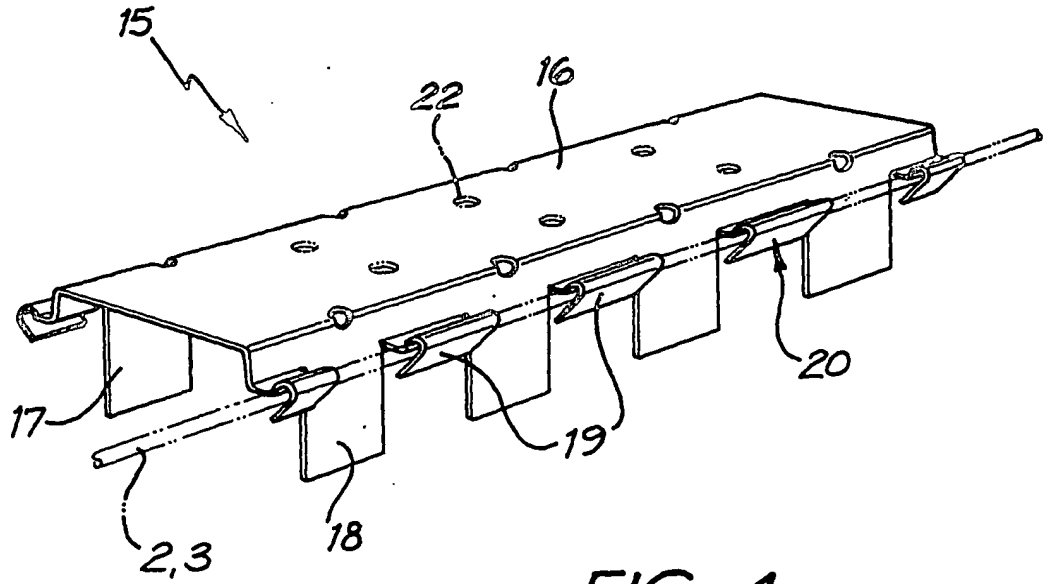


FIG. 3


15
22
16
17
19
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2,3
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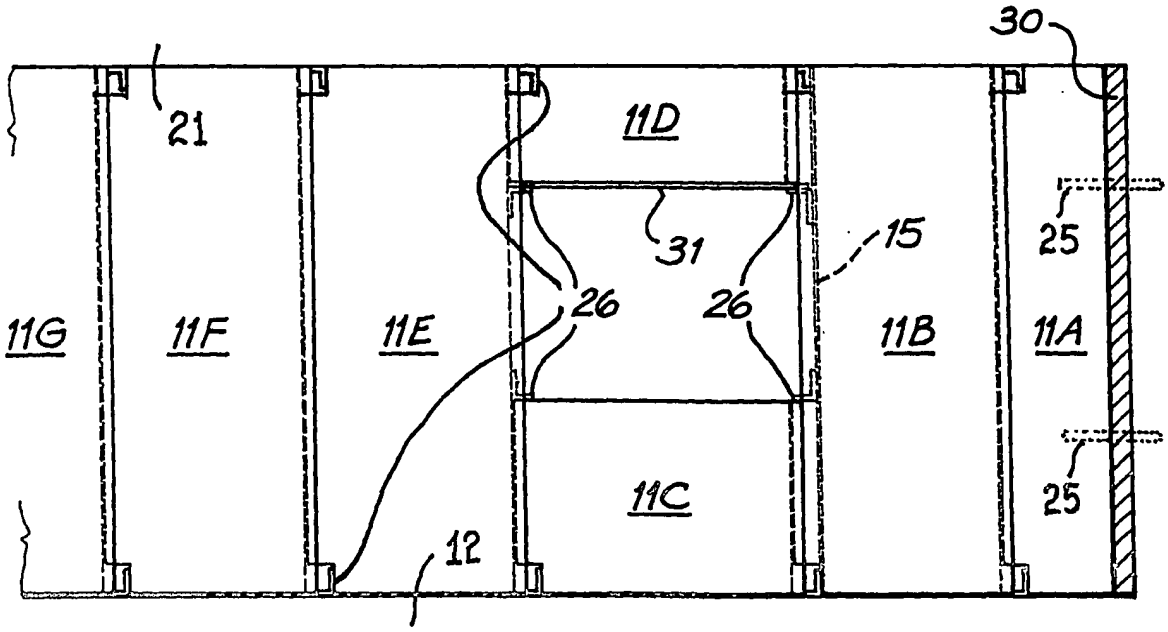
FIG. 4


30
21
11D
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11G
11F
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11B
11A
11C
25
12

FIG. 5

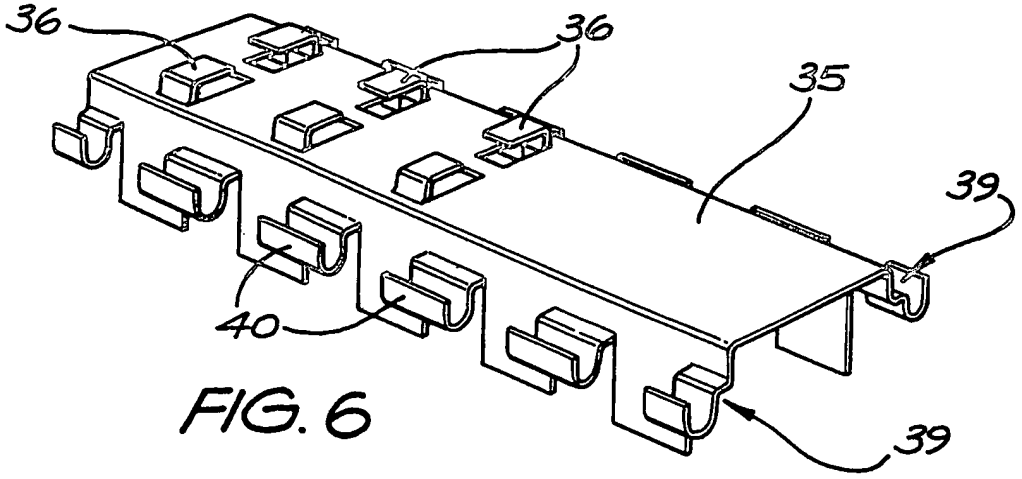

FIG. 6

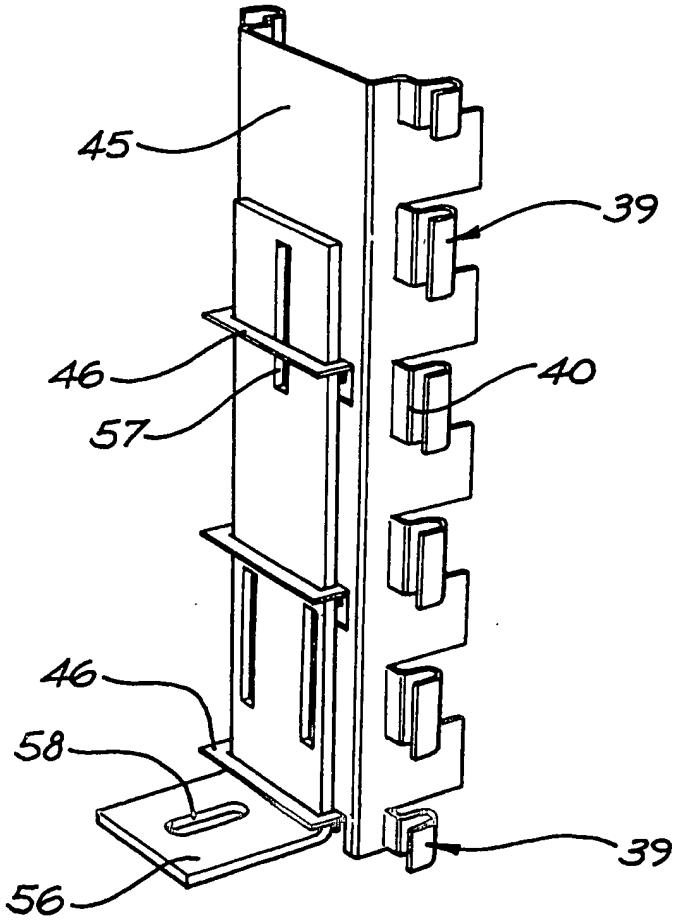

FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2004/000498

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl. [7]: E04B 2/72,1/41, E04C 5/18

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
DWPI + KEYWORDS(E04B, E04C, REINFORCE, BAR,MESH,ROD,PLATE,BRACKET,MOUNT, CONNECT, AUTOCLAVED,AERATED,CONCRETE,CEMENT,WALL,PANEL ETC.)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2000-087501 A (SUMITOMO METAL MINING CO LTD) 28 March 2000 See abstract and figures.	1-5,7,8, 10,14,18,21, 22
X	JP 2000-006134 A (ONODA AUTOCLAVED LIGHTWEIGHT CONCRETE CO LTD) 11 January 2000 See abstract and figures.	1-5,7,8,10,14
X	JP 7-224481 A (ACT JAPAN KK) 22 August 1995 See abstract and figures.	1-5,7,10,14,15
Y		1,2,7,10,11,12 ,13
X	US 4945704 A (BROWN, Jr.) 7 August 1990 See figures.	1,2,5,7,14

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

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Date of the actual completion of the international search	Date of mailing of the international search report
26 July 2004	- 2 AUG 2004
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized officer JONATHAN MILLS Telephone No : (02) 6283 2113

Form PCT/ISA/210 (second sheet) (January 2004)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2004/000498

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	DE 3220808 A1 (KIUNTKE) 8 December 1983 See figures 4-9 in particular.	1,2,7,10,11,12,13
P,X	AU 2003200719 A1 (MOBBS) 11 September 2003 See figures.	1,2,3,5,7,10

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/AU2004/000498

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report	Patent Family Member
JP 2000087501	
JP 2000006134	
JP 7224481	
US 4945704	
DE 3220808	
AU 2003200719	

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX